MINISTRY OF EDUCATION

SECONDARY ENGAGEMENT PROGRAMME

GRADE 10

CHEMISTRY

WEEK 11 **LESSON 1**

Topic: Acids, Bases and Salts

Sub-topic: Indicators and Acids

Objective: Given definitions of terms and observing pictures, students will prepare a homemade universal indicator and test the pH of at least 10 common household substances.

Content

Indicators: Indicators are substances that indicate the acidic or basic nature of the solution by the colour change.
Types of Indicator: There are many types of indicators. Some common types of indicators are:

1. **Natural Indicators:** Indicators obtained from natural sources are called Natural Indicators. Litmus, turmeric, red cabbage, China rose, etc., are some common natural indicators used widely to show the acidic or basic character of substances.
   Litmus: Litmus is obtained from lichens. The solution of litmus is purple in colour. Litmus paper comes in two colours- blue and red.
   An acid turns blue litmus paper red.
   A base turns red litmus paper blue.

   Turmeric: Turmeric is another natural indicator. Turmeric is yellow in colour. Turmeric solution or paper turns reddish brown with base. Turmeric does not change colour with acid.

   Red Cabbage: The juice of red cabbage is originally purple. The juice of red cabbage turns reddish with acid and turns greenish with base.

2. **Olfactory Indicator:** Substances which change their smell when mixed with acid or base are known as Olfactory Indicators. For example; Onion, vanilla, etc.
   Onion: Paste or juice of onion loses its smell when added with base. It does not change

its smell with acid.
Vanilla: The smell of vanilla vanishes with base, but its smell does not vanish with an acid.
Olfactory Indicators are used to ensure the participation of visually impaired students in the laboratory.

3. **Synthetic Indicators:** Indicators that are synthesized in the laboratory are known as Synthetic Indicators. For example; Phenolphthalein, methyl orange, etc.
Phenolphthalein is a colourless liquid. It remains colourless with acid but turns into pink with a base. Methyl orange is originally orange in colour. It turns into the red with acid and turns into yellow with base.

Universal Indicator:

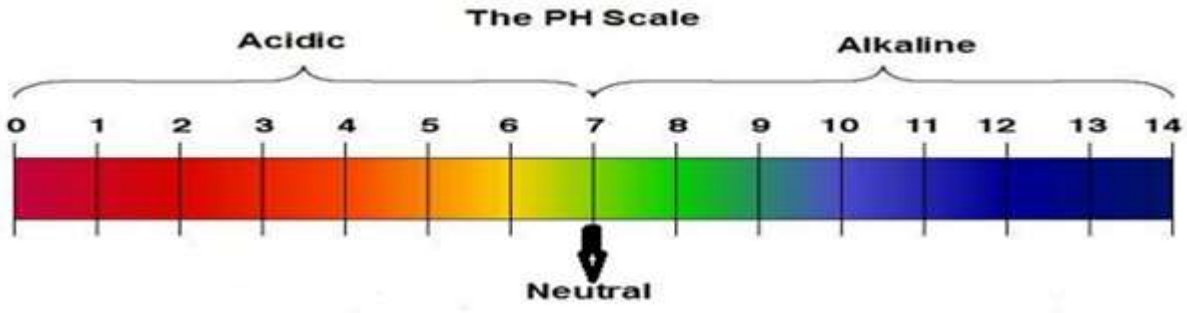
This is a substance that changes color when added to another substance depending on its pH. The indicator and the substance should be in aqueous form.

Table Showing Reaction of Indicators

Indicator	Original Colour	Acid	Base
Red litmus	Red	No Change	Blue
Blue litmus	Blue	Red	No change
Turmeric	Yellow	No Change	Red-brown
Red cabbage juice	Purple	Red	Green-yellow
Phenolphthalein	Colourless	Colourless	Pink

Testing pH

pH stands for **'potential of Hydrogen'** which measures the acidity or alkalinity of water-soluble substances. It is measured with a logarithmic scale known as pH.



A pH Scale

The pH of Common Acids

Fruits and vegetables tend to be acidic. Citrus fruit, in particular, is acidic to the point where it can erode tooth enamel. Milk is often considered to be neutral since it's only slightly acidic. Milk becomes more acidic over time. The pH of urine and saliva is slightly acidic, around a pH of 6. Human skin, hair, and nails tend to have a pH of around 5.

0 - Hydrochloric Acid (HCl)
1.0 - Battery Acid (H_2SO_4 sulfuric acid) and stomach acid
2.0 - Lemon Juice
2.2 - Vinegar
3.0 - Apples, Soda
3.0 to 3.5 - Sauerkraut
3.5 to 3.9 - Pickles
4.0 - Wine and Beer
4.5 - Tomatoes
4.5 to 5.2 - Bananas
around 5.0 - Acid Rain
5.0 - Black Coffee
5.3 to 5.8 - Bread
5.4 to 6.2 - Red Meat
5.9 - Cheddar Cheese
6.1 to 6.4 - Butter
6.6 - Milk
6.6 to 6.8 – Fish

Neutral pH Chemicals

Distilled water tends to be slightly acidic because of dissolved carbon dioxide and other gases. Pure water is nearly neutral, but rainwater tends to be slightly acidic. Natural water rich in minerals tends to be alkaline or basic. Pure Water has a pH of 7.0.

The pH of Common Bases

Many common cleaners are basic. Usually, these chemicals have a very high pH. Blood is close to neutral but is slightly basic.

7.0 to 10 - Shampoo
7.4 - Human Blood
7.4 - Human Tears
7.8 - Egg
around 8 - Seawater
8.3 - Baking Soda (Sodium Bicarbonate)
around 9 - Toothpaste
10.5 - Milk of Magnesia
11.0 - Ammonia
11.5 to 14 - Hair Straightening Chemicals
12.4 - Lime water (Calcium Hydroxide)
13.0 - Lye
14.0 - Sodium Hydroxide (NaOH)

Acids

An acid is any hydrogen-containing substance that is capable of donating a proton (hydrogen ion) to another substance.

Properties of Acids

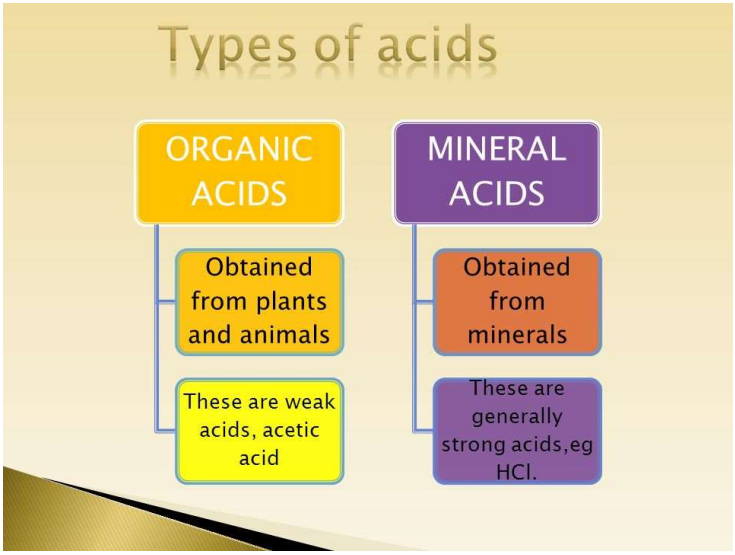
- Acids are corrosive.
- They are good conductors of electricity.
- Their pH values are always less than 7.
- When reacted with metals, these substances produce hydrogen gas.
- Acids are sour-tasting substances.
- Examples: Sulfuric acid [H_2SO_4], Hydrochloric acid [HCl], Acetic acid [CH_3COOH].

Uses of Acids

- Vinegar, a diluted solution of acetic acid, has various household applications. It is primarily used as a food preservative.
- Citric acid is an integral part of lemon juice and orange juice. It can also be used in the preservation of food.
- Sulfuric acid is widely used in batteries. The batteries used to start the engines of automobiles commonly contain this acid.
- The industrial production of explosives, dyes, paints, and fertilizers involves the use of sulfuric acid and nitric acid.
- Phosphoric acid is a key ingredient in many soft drinks.

Classification based on the source

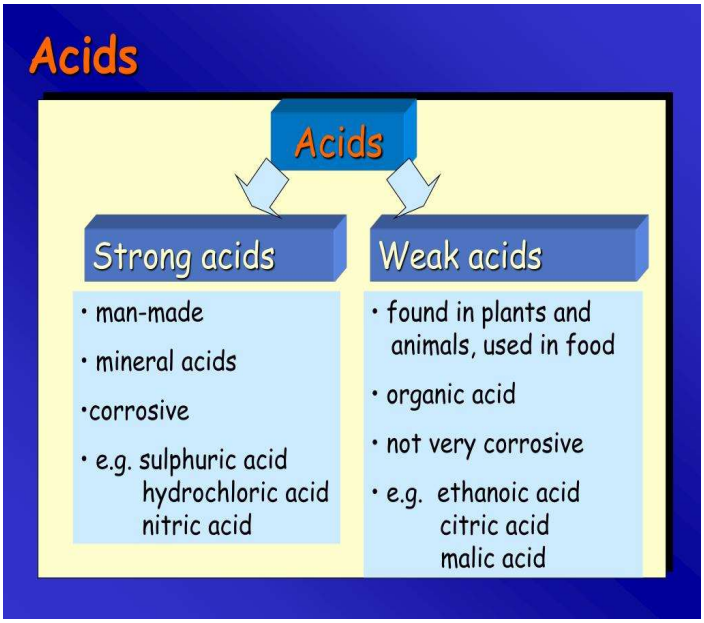
This means that acids are classified based on their source or origin. They are mainly of two types: Organic acid and Mineral acid.



Classification based on the Strength of the acid

Acids produce hydrogen ions when mixed with water, the strength of an acid depends on its concentration of the hydrogen ions present in a solution.

Strong Acids dissociate fully in water. This means that virtually all of the acid particles split into the ions they're made of. Strong acids release a larger number of H+ ions (protons) making the solution more acidic.

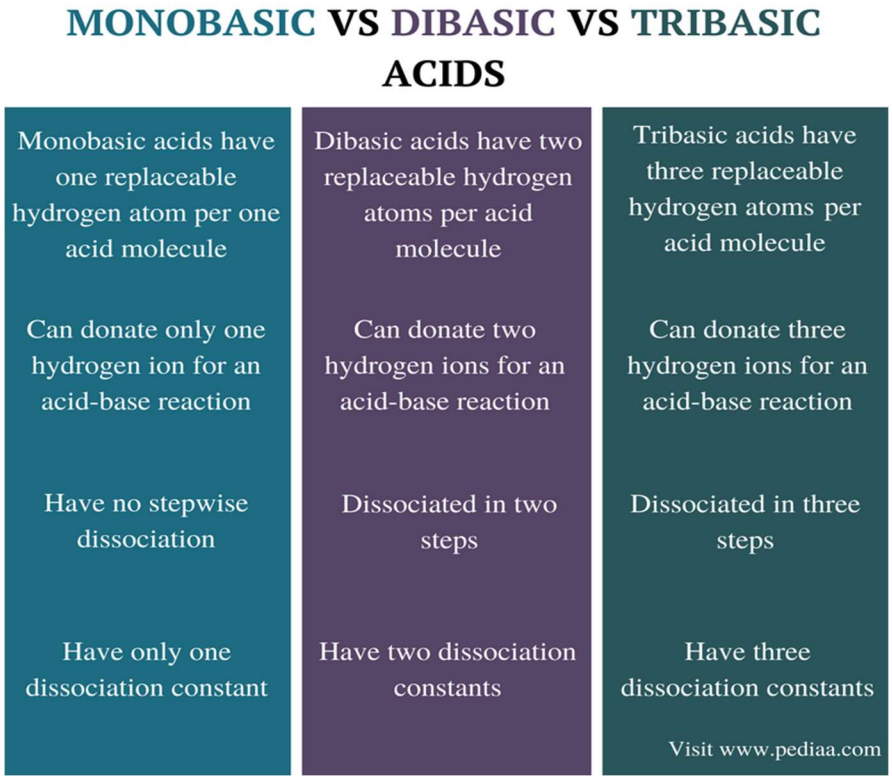


Weak Acids do not dissociate fully. Only some of the acid particles split into the ions they're made of. Weak acids release fewer H+ ions (protons) forming more weakly acidic solutions.

Concentration is the amount of solute (something that dissolves) that is dissolved in a certain amount of solvent (usually water). **Note the difference between concentration and strength**.

Classification based on the basicity of the acid

Acid on dissociation in water produces hydrogen ion. The number of these hydrogen ions that can be replaced in acid is the basicity of an acid.



Homework

Research on how to prepare an indicator using red cabbage. Make this indicator at home and test the pH of at least 10 substances found in the home.

References

1. https://www.thoughtco.com/ph-of-common-chemicals-603666
2. https://pediaa.com/difference-between-monobasic-dibasic-and-tribasic-acids/
3. https://slideplayer.com/slide/2560137/
4. https://www.slideserve.com/anahid/mrs-teocc